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## 1990 GYPSY MOTH SUPPRESSION ACTIVITIES

### ABERDEEN PROVING GROUND MARYLAND

#### PROJECT PARTICIPANTS

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# 1990 GYPSY MOTH SUPPRESSION ACTIVITIES

## ABERDEEN PROVING GROUND MARYLAND

### SUMMARY

On Sunday and Monday, May 6 and 7, 1990, approximately 10,600 acres at Aberdeen Proving Ground were aerially treated with an undiluted application of the *B.t.* (*Bacillus thuringiensis*) formulation Foray 48B applied at the rate of 20 billion international units (BIU) per acre. On May 12, a second undiluted application of Foray 48B was applied at the same rate to about 6,500 acres. The treatments were applied by the 356 TAS/Aerial Spray Branch using an Air Force C130 Hercules aircraft equipped with the Modular Aerial Spray System (MASS). Foliage protection was achieved throughout the majority of the areas treated. This project and a companion project at Fort George Meade represent the first operational use of the MASS-equipped C130 aircraft using a microbial insecticide for gypsy moth suppression.

### PROJECT PARTICIPANTS

The project was a cooperative effort between Aberdeen Proving Ground (Army), the 356 TAS/Aerial Spray Branch (Air Force), and the USDA Forest Service. The project required intensive coordination and cooperation with more than 50 tenant activities located on site whose daily activities were directly affected by the spray project. External coordination with the Maryland Department of Agriculture was also necessary to ensure that the C130 and aircraft working on the state's gypsy moth project were not operating in the same general area. Table 1 presents the names of those individuals who were directly involved on this project. Below are the specific agency responsibilities and key contacts.

#### Aberdeen Proving Ground (APG)

APG personnel planned this project and requested the services of the 356 TAS/Aerial Spray Branch to apply the *B.t.* APG prepared the necessary environmental documents, work plans, safety plans, and handled all other administrative duties. During the application APG provided the ground support crews who deployed helium-filled balloons to mark the flight lines and treatment area boundaries. They also arranged the services of an Army helicopter which was used to help mark the flight lines. APG procured the insecticide for both this project and the one at Fort George Meade. They also provided pumps, hoses, and other related equipment, in addition to people to support the insecticide loading operations. APG personnel assisted the USDA Forest Service with pretreatment and post-treatment monitoring. The APG Public Affairs Office maintained contact with the local media to notify nearby residents about the spray operation and to answer questions about it.

Contacts:	James Bailey	Abdul Shiekh
	Wildlife Resource Manager	Entomologist

#### Atmospheric Sciences Laboratory (ASL)

ASL is one of the many tenant activities at APG. To support the spray project they provided real time measurements of weather conditions in the spray blocks, and daily spot weather forecasts during the project.



Contact: Charles Clough  
Meteorologist

#### **Air Force**

The 356 TAS/Aerial Spray Branch provided the aircraft and personnel and a small pump to help load and apply the insecticide. The Air Force project entomologist worked with APG and Forest Service personnel during the planning and implementation of the project. The project entomologist also flew in the marking helicopter and maintained direct communication with the spray and monitor aircraft. Air Force personnel prepared maps depicting two possible flight line orientations based upon historical records of wind directions during the likely treatment period. These maps were provided to APG so that flight lines could be marked in the treatment area.

Contact: Terry Biery  
Entomologist

#### **US Army Materiel Command (AMC)**

The AMC entomologist actively worked with APG personnel during the planning phase for this project to assure compliance with Army regulations, and to facilitate any necessary command approvals. He provided technical assistance on site during the *B.t.* application.

Contact: Ron White  
Entomologist

#### **USDA Forest Service**

The Forest Service provided technical support to APG during the planning and implementation phases of the project. In February 1990, FS personnel cooperated with the Air Force and New Mexico State University to conduct characterization trials with the C130 spray system. FS personnel assisted APG in the preparation of environmental documents, helped train field crews, and provided crew leaders during the project. The Forest Service coordinated pre-treatment and post-treatment monitoring of insect and foliage conditions. During the project, the Forest Service provided a Cessna 210 and an observer to monitor the spray activity and to serve as the primary radio link between the spray aircraft and the ground crews. FS personnel deployed spray deposit cards to monitor the application, and conducted post-treatment evaluations. The Forest Service financed the suppression project.

Contact: Noel F. Schneeberger  
Entomologist

### **PROJECT AREA AND TREATMENT**

Aberdeen Proving Ground is an 89,000 acre US Army Materiel Command installation located along the upper Chesapeake Bay about 15 miles northeast of Baltimore, Maryland (Figure 1). The facility consists of two areas: Aberdeen and Edgewood.

The Aberdeen area includes large forested areas, wetlands, numerous tenant activities, firing ranges, test tracks, munitions storage facilities, barracks, administrative buildings, and Phillip's Army Air Field (AAF) among many other activities. Two spray blocks were located in the Aberdeen area (Figure 2). The first, Aberdeen North, consisted of about 4,300 acres. It was largely forested but contained numerous tenant



activities and firing ranges. The second treatment block, Abbey Point, consisted of about 2,800 acres. It was forested and largely uninhabited.

The third treatment block was located in the Edgewood area (Figure 2). It contained housing areas and a number of other tenant activities. The spray block consisted of about 3,400 acres.

The three treatment areas totalled of approximately 10,600 acres. These areas were selected by the wildlife manager and installation entomologist based upon their resource management objectives, and egg mass survey data provided by USDA Forest Service. All of the spray blocks except Abbey Point received two applications of *B.t.* formulated as Foray 48B . The insecticide was applied undiluted at the rate of 20 BIUs per acre (53 ounces/acre). No other adjuvants were added. Unique to the project was at least one active bald eagle nest in or near the treatment areas.

## AIRCRAFT AND EQUIPMENT

The treatment was applied using a four engine Hercules C130-E aircraft flown by the US Air Force, 356 TAS/Aerial Spray branch from Rickenbacker Air National Guard Base in Ohio. The aircraft was equipped with the new Modular Aerial Spray System (MASS) which had been cooperatively evaluated by the USDA Forest Service, US Air Force, and New Mexico State University at Las Cruces, NM in February 1990. The project at APG and a companion one at Fort George Meade represent the first time this aircraft and spray system has been used for aerial application of *B.t.* to control gypsy moth caterpillars.

The MASS is a modular system which can be removed from the aircraft thereby affording the aircraft a dual mission capability. Inside the aircraft, the MASS consists of pesticide tanks capable of holding up to 2000 gallons; a command console from which the spray operator regulates the flow of pesticide to the spray booms and monitors the entire system; and, the requisite pumps, hoses and plumbing necessary to move the pesticide through the system and out the spray booms. The spray system was continuously monitored during the application by the spray operator who fine-tuned the required calibration via flow rate controls on the command console. A summary of the spray aircraft configuration and spray parameters follows.

Aircraft/system:	Hercules C130-E w/MASS
Booms:	Long wing booms
Nozzles:	72-8030 Tee Jet, flat fan type
Orientation/spacing:	90° straight down; evenly spaced
Operating speed:	200 knots (338 fps)
Altitude:	150 feet AGL (above ground level)
Swath width:	600 feet
Application rate:	53 ounces/acre (0.41g per)
Desired flow rate:	117 gallons/minute

The spray project was staged from Phillip's AAF which is located at APG. The *B.t.* for both the APG and Fort Meade projects was delivered to Phillip's AAF in one large bulk tank (4500 gallons) and 28 drums (55 gallons each). Some initial problems were encountered trying to down-load the bulk tank due to odd size fittings that the tank required. As a result the *B.t.* in the drums was used for the first load. Reloading the C130 was generally accomplished in 20-40 minutes depending upon the amount loaded.

Phillips AAF did not have a large refueling capability so the C130 had to refuel periodically at Glenn L. Martin State Airport located about 10 miles southwest of Phillips AAF. Some spraying time was lost as a result.



## GROUND SUPPORT/LOGISTICS

The characterization trials conducted in Las Cruces, NM in February 1990 resulted in several special conditions being recommended for this project. These were:

- 1) 600 feet lane separation
- 2) crosswind spraying only (45° minimum)
- 3) 5 knot crosswind speed

Strict adherence to these criteria was necessary, as one objective of this spray mission was to demonstrate the capability of the C130 system to perform this type of work. All cooperators recognized the situation and accepted these criteria. This decision resulted in some unique implication for the type and level of ground support and logistical planning that was required.

### Flight Lines

Air Force personnel prepared two original USGS 7 1/2 minute topographic maps for each of two possible spray flight orientations. These orientations were selected to accommodate the spray block configurations, and the most likely wind directions during the month of May based upon historical weather data provided by ASL personnel on site. The flight line orientations also took into account efficient use of the C130 and flight crew stamina. The maps were sent to APG so that the flight lines could be marked in the treatment areas. APG and FS personnel developed a plan to have ground crews deploy balloons at predetermined stations along each flight line to help the spray pilot maintain the required 600 feet lane separation.

The first flight plan was referred to as the ORANGE Plan and consisted of flight lines oriented at 220° (40° back bearing) (Figure 3). It accommodated northwesterly and southeasterly winds (Figure 4). The second flight plan (WHITE Plan) consisted of flight lines oriented at 250° (70° back bearing) (Figure 5). It accommodated more northerly and southerly winds (Figure 6). Together both plans covered all wind directions except a 60° window in the southwestern and northeastern quadrants (Figure 7).

The ORANGE Plan was the most efficient flight orientation for treating the Aberdeen-North and Abbey Point treatment areas. This plan offered the longest and the least number of flight lines (28 versus 40) to complete the job. The WHITE Plan, however, was the most efficient flight orientation for treating the Edgewood Area. It not only offered the longest and the least number of flight lines (16 versus 32), but also did not require the C130 to make low level approaches over residential areas in the nearby communities of Edgewood and Magnolia.

APG and FS planners decided to establish two balloon marking stations along each flight line in the Aberdeen-North spray area; one station along each flight line in the Abbey Point spray area; and two stations along each flight line in the Edgewood area. Most of the stations were located along hard surface roads. An orange and white number, representing the flight line number in each of the WHITE and ORANGE Plans, were painted on the road surface. The balloon stations were later identified on field maps as representing balloon lines A and B (Aberdeen North), C (Abbey Point) and D and E (Edgewood) (see Figures 8-12).

Just prior to the first application APG personnel were able to procure a helicopter from Phillips AAF to assist with flight line marking in all three spray blocks.

### Field Crews

Two crews of two persons each, and one balloon crew coordinator were assigned to the balloon lines (A,B,C,D,E). Each group and its coordinator were responsible for deploying balloons along their respective



balloon lines. The line coordinator's job was to see that his or her crews were positioned properly. For example, crew #1 would position themselves at their assigned balloon station and deploy a 30 inch helium-filled balloon. In the meantime, Crew #2 would drive to the balloon station on the next flight line, and wait for orders. Crew #1 would retrieve their balloon after the C130 passed overhead. Crew #2 would then deploy their balloon while crew #1 drove to the station on the next flight line. The two crews would leap frog as such from flight line to flight line.

The line coordinator made sure that this process proceeded smoothly, and reported via radio directly to the project coordinator who was in contact with the spray aircraft. In practice, this process did not work as smoothly as hoped. Many crews could not find their assigned stations; the field maps were xerox copies and hard to read, and the main road (balloon line C) in the Abbey Point spray block was too narrow to allow vehicles to pass one another thus impeding the designed leap frog process.

An Army helicopter was secured from Phillips AAF and used to help mark the flight lines. The aircraft would select a balloon station at the end of a flight line and hover at 600 feet above ground level over the balloon. With lights turned on and facing the oncoming C130, the helicopter was very visible to the spray pilot, which aided in keeping the C130 on line.

Additional field crews deployed helium-filled balloons along the spray block boundaries. In all, more than 20 people were providing ground support.

## **Communications**

Maintaining adequate communications between field crews, observation aircraft and spray aircraft was critical to the success of the project. The project coordinator, balloon line coordinators and balloon deployment crews utilized hand-held radios provided by the Operations Division. These radios were tuned to a frequency monitored by Range Control personnel so that they were aware when treatments were initiated and completed and could stop and start their firing operations. The C130 and marking helicopter communicated where possible on civilian aircraft frequencies (usually 123.45). Neither aircraft had a direct communication link with the ground crews. This critical air to ground link was provided by an aerial observer flying in a civilian Cessna 210 aircraft.

The communication procedure went as follows: The C130 pilot contacted the marking helicopter with the flight line number completed and the flight line number to be flown next. The helicopter passed that information to the observation aircraft, which contacted the field crews using one of the hand-held radios. Forest Service radios were used as a back-up to the hand-held radios. This procedure worked fairly well as long as all three aircraft were in the air at the same time. Communications between the observer aircraft and ground crews were spotty at times, as was direct communication between crews.

## **PROJECT NARRATIVE**

The 356th TAS/Aerial Spray Branch arrived at APG on Tuesday, May 1. That afternoon they held an entrance briefing with all involved parties. The ASL meteorologists reported that rain was likely on Thursday and Friday with clearing due on Saturday. This would give the APG personnel several more days to prepare ground crews.

On Wednesday, May 2, the Air Force flew practice runs first at APG. The practice runs highlighted several things. First, the use of a helicopter to help mark the flight lines would very likely help a great deal. Second,



the ground coordination with the field crews needed much more work in the following areas: location of balloon sites, deployment procedures, and communications.

The weather forecast was not favorable over the next few days so no treatments were planned before Sunday, May 6. On that day, field crews met at 0700 hours and after a short briefing proceeded to their assigned stations. The ASL meteorologists forecasted winds from 330° to 340° at 6-11 knots, and temperature ranging from 55° to 65°F. The WHITE flight plan was selected. Spraying commenced at 0900 hours. The Abbey Point block was treated first and completed about 1100 hours (Figure 8). At that time the helicopter and observation aircraft went to refuel while the C130 landed to reload with *B.t.* Treatments resumed on line 32 of the Aberdeen-North block at about 1140 hours and proceeded to about 1240 hours when problems developed with the spray system. The mission was cancelled for the day after treating down to line 23 (Figure 9).

Air Force technicians checked the aircraft spray system and found the 50 mesh in-line screen to be clogged with very fine sediment and elastic-like debris. There was not any indication from where the contamination may have originated.

In total, 1624 gallons of *B.t.* were applied on 3,920 acres. Light rain was reported locally in the spray block about 3 hours after treatment and again later that evening. No accumulation, however, was recorded at any of the ASL weather stations on site or nearby. During the approximate 4 hour treatment period temperatures ranged from 57° to 65°F.; relative humidity was 60 percent at the start of treatment and dropped to 43 percent when the mission was cancelled for the day; and wind speeds averaged 5 to 7 knots, with peak gusts ranging from 9 to 15 knots.

On Monday, May 7, plans were made to continue using the WHITE Plan and to begin treating the Aberdeen-North spray area starting on line 22. The field crews were positioned and the aircraft was in the air at 0815 hours, but the wind changed direction. The spray aircraft returned to the airport and the field crews were put on standby until the project coordinator and entomologists could assess the situation.

The wind shift made the ORANGE Plan acceptable and plans were set in motion to resume treatments beginning on flight line 60 and proceeding to line 40 (Figure 9). Some minor field adjustments were made to accommodate this change in plans. Treatment resumed at 0930 hours and the Aberdeen-North block was completed without any problems at 1115 hours. During the treatment period temperatures ranged from 60° to 65°F.; relative humidity was 53 percent initially and dropped to 37 percent by the time the treatment was completed; and winds averaged 4 to 6 knots with peak gusts ranging from 9 to 13 knots. A total of 1347 gallons of *B.t.* was applied on 3253 acres.

Treatments commenced at the Edgewood Area at about 1230 hours (Figure 10). Communication between APG and AF personnel was not clear so not all of the ground crews were on site when the C130 arrived at Edgewood. The helicopter appeared able to mark the flight lines until the ground crews arrived. The treatment continued until about 1400 hours when the C130 left for Glenn L. Martin State Airport, about 10 miles away, to refuel. The aircraft returned on site at 1530 hours and completed treating about 1630 hours. During the treatment period temperatures ranged from 67° to 72°F.; relative humidity was between 34 and 36 percent; and the winds averaged 6 to 8 knots with peak gusts ranging from 11 to 19 knots. A total of 1442 gallons of *B.t.* was applied on 3483 acres.

This completed the first application of *B.t.* at APG. In total, the C130 applied 4,413 gallons of *B.t.* representing 10,656 acres treated.

The second application of *B.t.* was completed on Saturday, May 12. The field crews assembled at 0545 hours but before they could leave for the spray block the wind changed direction. Neither flight plan (ORANGE or WHITE) accommodated the current wind direction, so AF personnel quickly drew up another plan, a copy of which was subsequently given to the field crews. At 0745 hours the aircraft lifted off but returned to the airport at 0800 hours because the wind had changed direction again. At this point, the field crews were placed



on standby and everyone took a breakfast break until the wind stabilized. The AF personnel raised a concern about crew rest period since the crews were called to duty at 0430 hours. The project needed to begin treatment by 0930 hours in order to complete the mission that day.

The wind did stabilize and the spraying commenced at 0930 hours over the Aberdeen-North spray block using the ORANGE Plan (Figure 11). Flight lines 42 to 59 were completed by about 1100 hours and the C130 returned to the airport to load the remaining *B.t.* As there was less *B.t.* remaining than expected, the project coordinator decided to resume treatment at the Edgewood Area which was a higher priority. Any leftover *B.t.* would then be applied to the Aberdeen-North area.

The treatment at Edgewood commenced at 1245 hours and was completed at 1400 hours. The WHITE Plan was used to avoid low level approaches over nearby communities (Figure 12). There was not enough *B.t.* to complete all of the Edgewood or Aberdeen-North areas. In total, 1345 gallons of *B.t.* were applied to 3248 acres at Aberdeen-North, and 1358 gallons to 3280 acres at Edgewood. During the treatment period at Aberdeen-North, the temperatures were 56° to 58°F.; relative humidity was 42 to 44 percent; and winds averaged 5 to 6 knots with peak gusts ranging from 10 to 12 knots. Temperatures and relative humidity were similar during the treatment of the Edgewood area, and the winds averaged 4 to 5 knots with peak gusts of 8 to 11 knots.

This completed the second application of *B.t.* and the 1990 spray project at APG. In total, 7116 gallons of *B.t.* were applied on 17,186 acres at APG.

## PROJECT MONITORING

The Forest Service, in cooperation with APG personnel, conducted a number of monitoring activities prior to, during, and following treatment (Figures 13-17).

### Pre-Treatment Monitoring

Prior to treatment, eight egg mass survey sites in and near the treatment areas were established by FS personnel (Figures 13-15). A cluster of three 1/40th acre fixed-radius plots was established and egg mass data collected. Egg mass counts ranged from about 100 to more than 25,000 per acre.

Six sites were established to monitor the development of tree foliage and gypsy moth eggs and larvae. APG personnel at Aberdeen and Edgewood monitored the sites and collected the necessary data approximately every three days beginning in April and ending on about May 11. In addition these dates were used to establish the optimum treatment dates.

A total of about 335 larvae were collected from monitoring points on May 7 and May 12. These were returned to the laboratory where developmental stage was determined and compared to the field estimates. A summary of the key larval and foliage development indicators and dates is presented in Table 2.

At the time of the first *B.t.* application on May 6 and 7 all oak foliage was estimated to be 50 percent or more expanded, and the majority of larvae were first and second instar (laboratory examination). Field and laboratory observations of larvae collected on May 11 (second application) indicated that the majority were second and third instars. Also on May 11, field observations noted as much as 50 percent larval mortality present in second instars and as much as 20 percent mortality in thirds.



## Treatment Monitoring

Insecticide deposition was monitored using white kromekote cards (2"x3") which were deployed on wire holders 18 inches above the ground. Two card lines were established in the Aberdeen-North treatment area (Figure 13), and one card line was established in each of the Abbey Point and Edgewood treatment areas (Figures 14-15). The cards were positioned 300 feet off the prescribed flight lines with a nominal spacing of 600 feet between each card. The purpose of using spray deposit cards was to examine if and how well the undiluted *B.t.* was penetrating the tree crowns. If insecticide drops were observed on the cards then it was assumed that the *B.t.* was also depositing in the tree canopy overhead.

Following each application the cards were carefully collected and placed in a card holder box, and taken back to the office where they were examined using an image analyzer. Drop densities and sizes varied between individual spray cards, card lines, and first and second applications. This is not surprising since few cards were deployed in large open areas free from overhead vegetation. All cards, however, did show some deposition. Average drop density and VMD for the first application were about 5 drops/cm<sup>2</sup> and 161 microns. For the second application drop densities averaged about 3 drops/cm<sup>2</sup> and VMD averaged about 144 microns, over the entire treatment area.

## Post Treatment Monitoring

Six stations were set up in the treatment area to monitor larval populations following the *B.t.* application (Figures 13 and 15). Each station consisted of five oak trees banded with a 12 inch swath of burlap. Beginning on May 15 and about every 3 days thereafter, the number of live larvae under each burlap was recorded. Data were last collected on May 23. Figures 16 and 17 illustrate the results of the larval data for all six stations. At all monitoring sites larval populations dropped drastically following *B.t.* application. At only one site (point B) located in the Aberdeen-North treatment block did larval numbers increase.

An aerial survey for tree defoliation was accomplished in June. The results were reported in a separate letter dated August 1, 1990. In summary, 90 acres of heavy defoliation (>60 percent) and 171 acres of moderate defoliation (31-60 percent) were detected in the treatment areas. All of the moderate and a sizeable portion of the heavy defoliation occurred in the Edgewood treatment area.

## DISCUSSION AND RECOMMENDATIONS

This project evolved into something more complex and challenging than anyone imagined. The number of people required on the ground, their pre-treatment training needs, the unavailability of fuel for the C130 at Phillips AAF, the treatment weather criteria, and the level of communication and coordination needed between Army, Air Force, and Forest Service personnel, are but a few areas that separated this project from others. The APG project represented a number of firsts.

1. This was the first large scale gypsy moth spraying project at APG.
2. This was the first time the Air Force C130-E equipped with the MASS was used to apply a microbial insecticide for gypsy moth control over a large forested area.
3. This was the first time the USDA Forest Service financially supported the use of the MASS-equipped C130 for forest pest suppression.



This project highlighted some lessons for all of the cooperators. Most of these were identified and discussed during the project review held on July 10 at APG, and will not be addressed in this report. However one theme that was pervasive throughout the review was the need to begin the planning process earlier, that is, provide more lead time for those involved, and identify equipment, supply and personnel requirements and the duration needed.

The following are several other observations and recommendations for your consideration in future projects.

1. There was excellent cooperation between the project coordinator and the affected tenant activities this past year; however it wasn't until the treatments began that the extent of that impact on the tenant activities became known. Beginning the planning process earlier for 1991 and incorporating key people at an earlier stage during this process will help ensure that critical deadlines are met, that equipment, supply and personnel needs are known, and that the potentially impacted tenant activities are prepared well in advance.

Some key offices and departments to involve early maybe: contracting, purchasing, budget and fiscal, operations, range control, public affairs, safety, clerical support, and the command at APG. Several recommendations are appropriate here.

Recommendation: Develop a planning team for 1991 now and begin periodic meetings with key personnel and offices. Obtain command priority for the project.

Recommendation: Develop an organizational structure and identify critical jobs and clearly define specific responsibilities.

Recommendation: Develop a work and safety plan specific for the planned project. Integrate a safety officer into the project organization and identify specific responsibilities.

Recommendation: Develop a communications plan to include who will have radios, what frequencies will be used as primary and backup, and the communication procedure. Train ground personnel in the proper use of radios.

Recommendation: Look for opportunities to coordinate purchase of supplies, insecticide, and services with other installations.

2. APG was able to mobilize a sizable contingent of dedicated people to provide the necessary ground support. Unfortunately most of these individuals were not available in advance of the treatment to become familiar with the balloon point locations, to practice the balloon deployment procedure, and to become fully familiar with their specific responsibilities. In addition when the ground crews finally got to the field to practice the deployment procedures they were not able to visit all of the balloon stations because the firing ranges were active. As a result there was some confusion that occurred during the first *B.t.* application as ground crews had to learn and practice the deployment procedures as they went along.

Recommendation: Continue to draw upon this dedicated group of people for ground support with the following provisions:

- a) Secure their services for a block of time including some time prior to project commencement.



- b) Conduct as many "dry runs" as necessary to make sure that ground personnel know their duties. Use weekends when ranges are cold, if necessary.
- c) Train the field crews as necessary to use radios, road maps, etc.

3. Flight line marking with field crews and helium-filled balloons was a logistical and personnel management challenge. It was successfully met and implemented. We learned, however, that the C130 pilot had difficulty seeing the small balloons. The use of the helicopter to help mark the flight lines worked out extremely well, and improved the spray pilot's ability to stay on line. If a second helicopter could have been obtained to help mark flight lines, APG could have greatly reduced the number of ground personnel needed. In many cases no balloons would be necessary because the helicopter could spot the field trucks and position themselves accordingly.

Recommendation: Secure the services of at least 2 helicopters to mark flight lines and request their availability for a block of time. Two more helicopters could be held in reserve to replace the first two at refueling time so as to continue the spraying operation.

4. The maps used in the field by ground crews, pilots and aerial observers were black and white copies of original topographic maps. These were hard to read because features that stand out on original color maps, such as forests, open areas, roads and trails, were often not apparent on the copies.

Recommendation: Secure a sufficient supply of original, color topographic maps upon which to place all pertinent information. All project personnel should have an original map.

5. Daily communication and coordination between all project participants was not always up to par. Specifically we lost valuable time every morning mobilizing the field crews and making sure that they knew the plan for the day. This in great part can be attributed to not being able to work with the ground crews anytime prior to the project (see #3). In addition there were some coordination gaps between the project participants during the first application. This resulted in the Edgewood area being treated before APG could dispatch field crews to that area. Finally the overall radio communications between all participants was not adequate which undoubtedly contributed to these coordination lapses. Several steps could be taken to address the situation.

Recommendation: Radio communications need to be upgraded. APG Range Control plans to have a new radio system in place this fall which is designed to provide a quality radio link APG-wide. This may address the ground communication gaps that occurred. This new radio system should be tested sometime before being used on any future project.

Recommendation: The Forest Service's cellular telephones proved to be a reliable communication link supplementing the radios. Consider equipping key project personnel, including the project coordinators, ground crew coordinators, and someone at the mixing and loading site, with a cellular telephone. These can be rented for the project duration.

Recommendation: Key project participants should convene every afternoon to assess the morning's accomplishments and to develop an operations plan for the next day. Participants should include the project coordinator, the Air Force entomologist, mission commander (and/or pilot), the spray operator, ground crew coordinators, and any other key participants.



Recommendation: Conduct a morning field crew briefing and provide crews with a written copy of the operations plan for that day.

6. The insecticide loading operations did not go as smoothly as hoped. For example, the bulk tank containing the *B.t.* required an odd size fitting in order to off-load the material. This could have delayed the operation, however we were able to draw *B.t.* from the 28 - 55 gallon drums instead, while a fitting for the bulk tank was being secured. Furthermore adequate pumps, meters and sufficient hoses had to be located and brought on site at various times during the operation.

Recommendation: APG, Air Force and the insecticide manufacturer's representative should meet well in advance of the project to discuss and identify the specific equipment and supplies that will be needed to mix and load the insecticide.

Recommendation: An Air Force "preaction" team could work with APG and review needed supplies, equipment, personnel, logistics, etc.

Recommendation: APG needs to secure the required equipment and the personnel to operate such for a sufficient block of time.

7. Should the MASS-equipped C130 be used in future projects or should a private applicator be hired? There is no simple answer to this question, as both have advantages and disadvantages. If future projects involve large acreage away from populated areas, then the C130 system may be the most appropriate. If the Edgewood area is treated again, a private applicator might be more appropriate in order to minimize complaints from adjacent communities.

Recommendation: Retain all treatment options. Select the type of equipment that best meets the job to be accomplished.

Once again, this was a project of firsts and many lessons were learned. Everyone who participated from APG and 356 TAS/Aerial Spray should be commended for taking on such a challenging and logistically complex project, and completing it within the required time schedule.



## APPENDIX

Tables 1-2

Figures 1-17



Table 1.-- Gypsy Moth Suppression Project Participants,  
Aberdeen Proving Ground, May 6-7 and May 12, 1990.

356 TAS/Aerial Spray - Insecticide Loading and Application

- |     |                        |     |                      |
|-----|------------------------|-----|----------------------|
| 1.  | Kevin R. Beck          | 11. | Eugene F. Lucas      |
| 2.  | Timothy R. Bellamy     | 12. | Kenneth D. Mason     |
| 3.  | Terry L. Biery         | 13. | Randy L. Miller      |
| 4.  | James E. Bonnlander    | 14. | Lundy G. O'Dell      |
| 5.  | Michael W. Burgett     | 15. | Edward L. Rooks      |
| 6.  | Mark D. Darby          | 16. | William A. Rooks     |
| 7.  | David M. Deckman       | 17. | Donald G. Seitzinger |
| 8.  | Sandy L. Harold        | 18. | Kenneth N. Snyder    |
| 9.  | Marshall D. Hutchinson | 19. | David R. Wiles       |
| 10. | Ernest G. Johnson      | 20. | Michael J. Hall      |

Aberdeen Proving Ground - Planning, Aerial and  
Ground Support and Logistics

- |    |                                 |     |                     |
|----|---------------------------------|-----|---------------------|
| 1. | Jim Bailey                      | 8.  | Gordon Barber       |
| 2. | Abdul Shiekh                    | 9.  | Barbara Filbert     |
| 3. | LTC S. Wood                     | 10. | Jeffrey Lindblad    |
| 4. | LTC S. Edwards                  | 11. | Gary Campbell, CW-4 |
| 5. | Maj. J. Pete                    | 12. | Charles Clough      |
| 6. | Capt. D. Johnson                | 13. | Wayne Kaiser        |
| 7. | Ronald White (AMC Entomologist) | 14. | James McCain        |
- more than 20 other people providing ground support -

USDA Forest Service - Ground Support and Project Monitoring

- |    |                      |    |                      |
|----|----------------------|----|----------------------|
| 1. | Noel F. Schneeberger | 5. | Karen D. Felton      |
| 2. | Bradley P. Onken     | 6. | Christopher D. Voigt |
| 3. | Rodney L. Whiteman   | 7. | Dennis Warner        |
| 4. | Kelly S. Riddle      | 8. | Alan J. Iskra        |



Table 2.--Summary of Developmental Conditions and Dates

### INSECT DEVELOPMENT

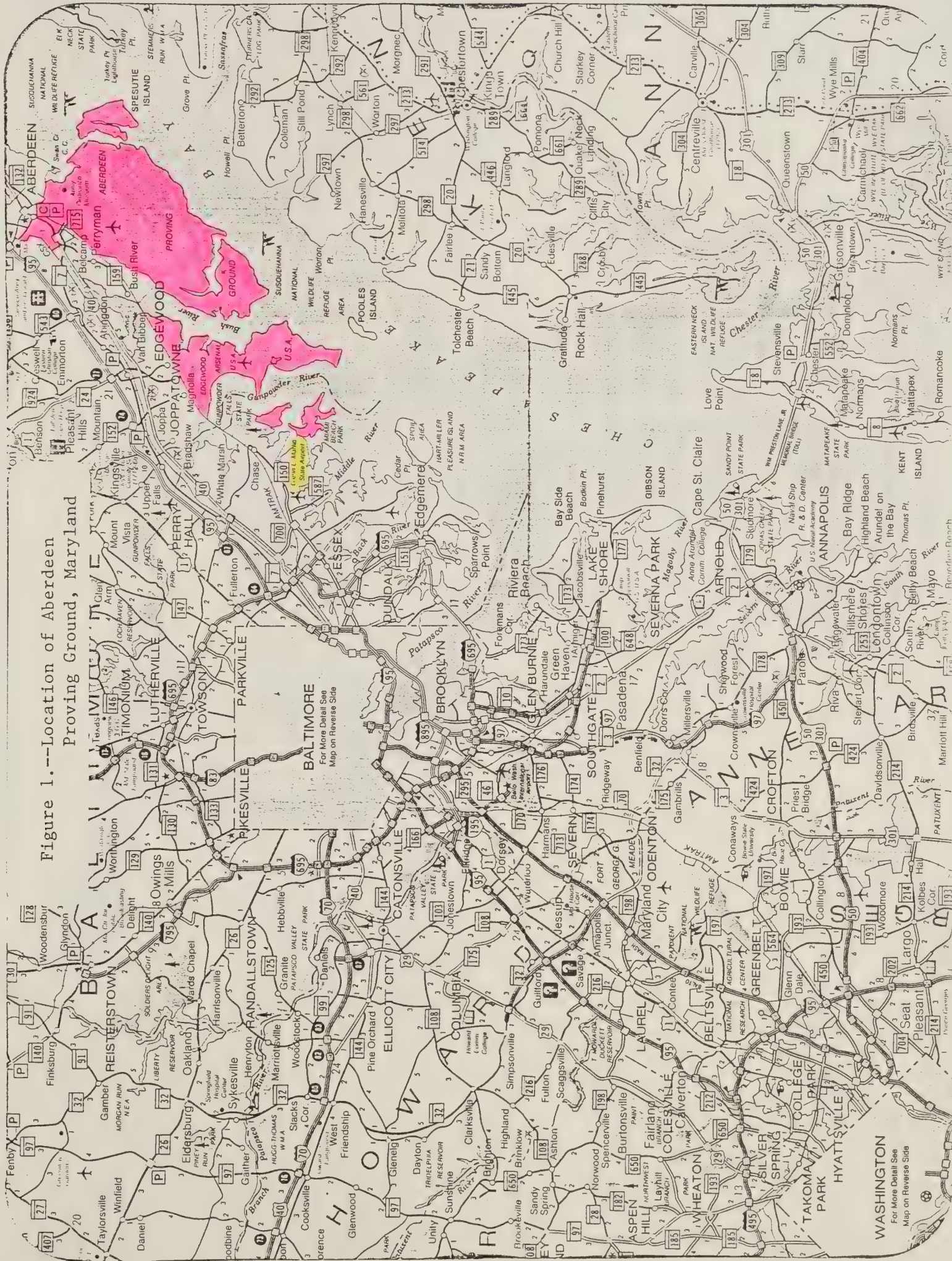
April 17	30% Egg Hatch
April 28	100% Egg Hatch 90% Dispersal
May 4	48% 1st Instar 52% 2nd Instar
May 7 (Field Observations)	0-18% 1st Instar 13-69% 2nd Instar 14-87% 3rd Instar
May 7 (Laboratory Observation)	18% 1st Instar 75% 2nd Instar 7% 3rd Instar
May 11 (Field Observation)	0% 1st Instar 20-35% 2nd Instar 65-80% 3rd Instar
May 11 (Laboratory Observation)	0% 1st Instar 35% 2nd Instar 64% 3rd Instar 1% 4th Instar

### FOLIAGE DEVELOPMENT

April 17	Bud swell on oaks
April 24	WO: Bud break - 5% leaf expansion RO: 5-10% leaf expansion
April 26	5-15% leaf expansion (RO & WO)
May 4	25-50% leaf expansion (WO) >50% leaf expansion (RO)
May 7	>50% leaf expansion (RO & WO)
May 11	>50% leaf expansion (RO & WO)

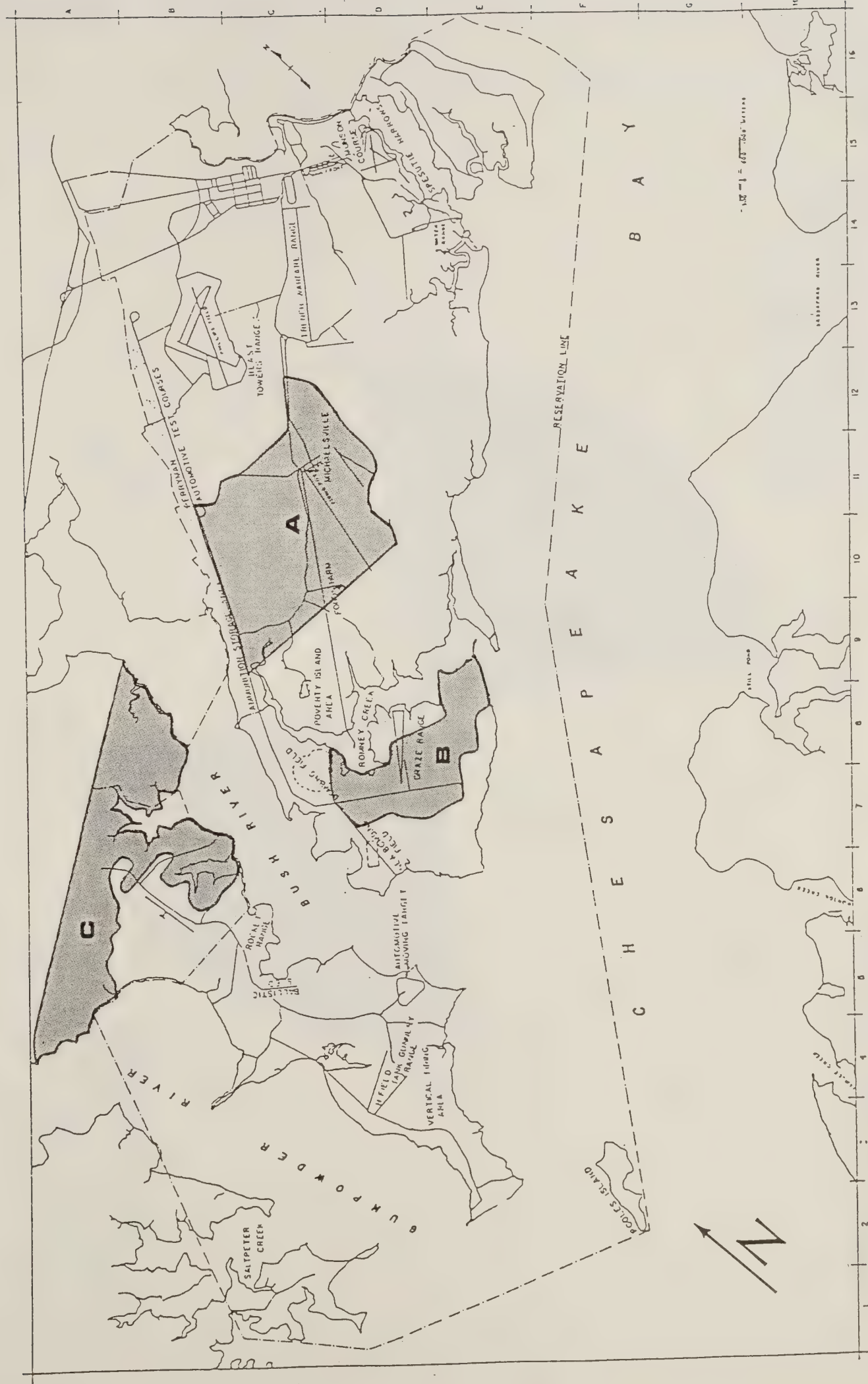


Figure 1.--Location of Aberdeen Proving Ground, Maryland





# ABERDEEN PROVING GROUND

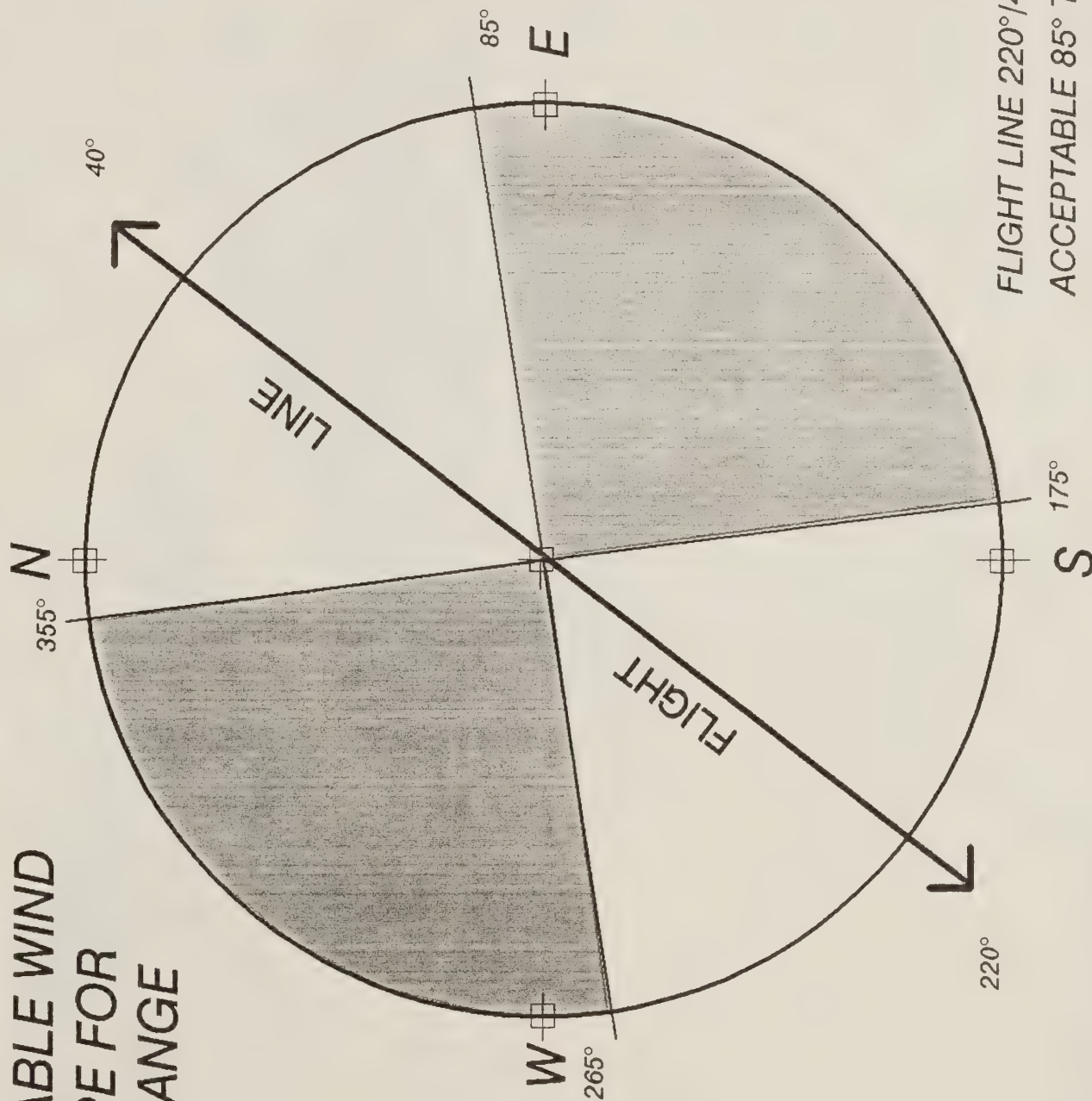


A = Aberdeen - north  
 B = Abbey Point  
 C = Edgewood

Figure 2. -- Location of three spray blocks (A,B,C).  
 1990 Treatment Area. Aberdeen Proving Ground,  
 Maryland.



# ACCEPTABLE WIND ENVELOPE FOR PLAN ORANGE



GRAPHIC PREPARED BY USDA, FOREST SERVICE,  
FOREST PEST MANAGEMENT, MORGANTOWN, WV.



FIGURE 3.

ABERDEEN PROVING GROUND, MD



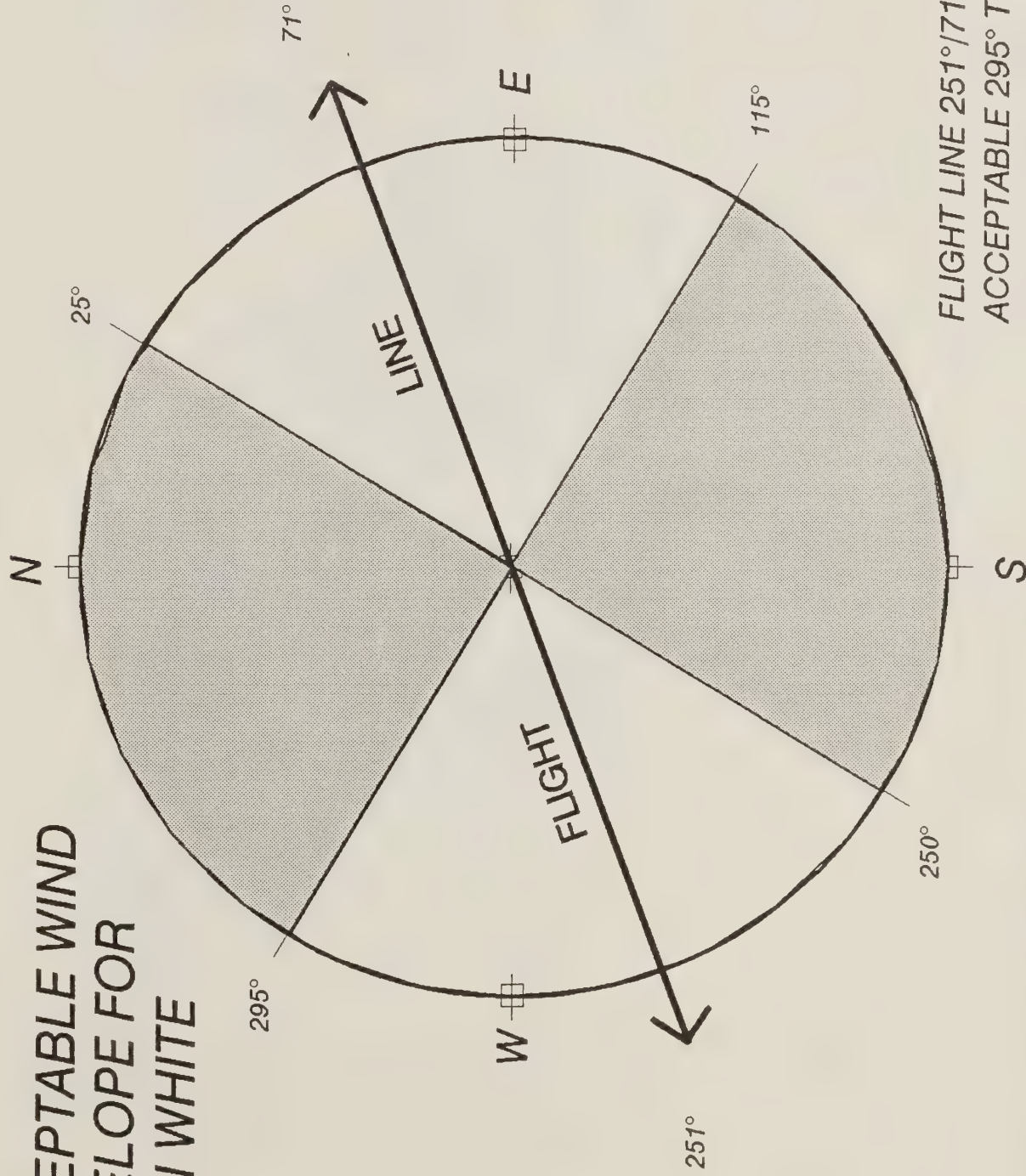
[illegible]

### Legend

-  = spray block areas  
 = flight lines



# ACCEPTABLE WIND ENVELOPE FOR PLAN WHITE



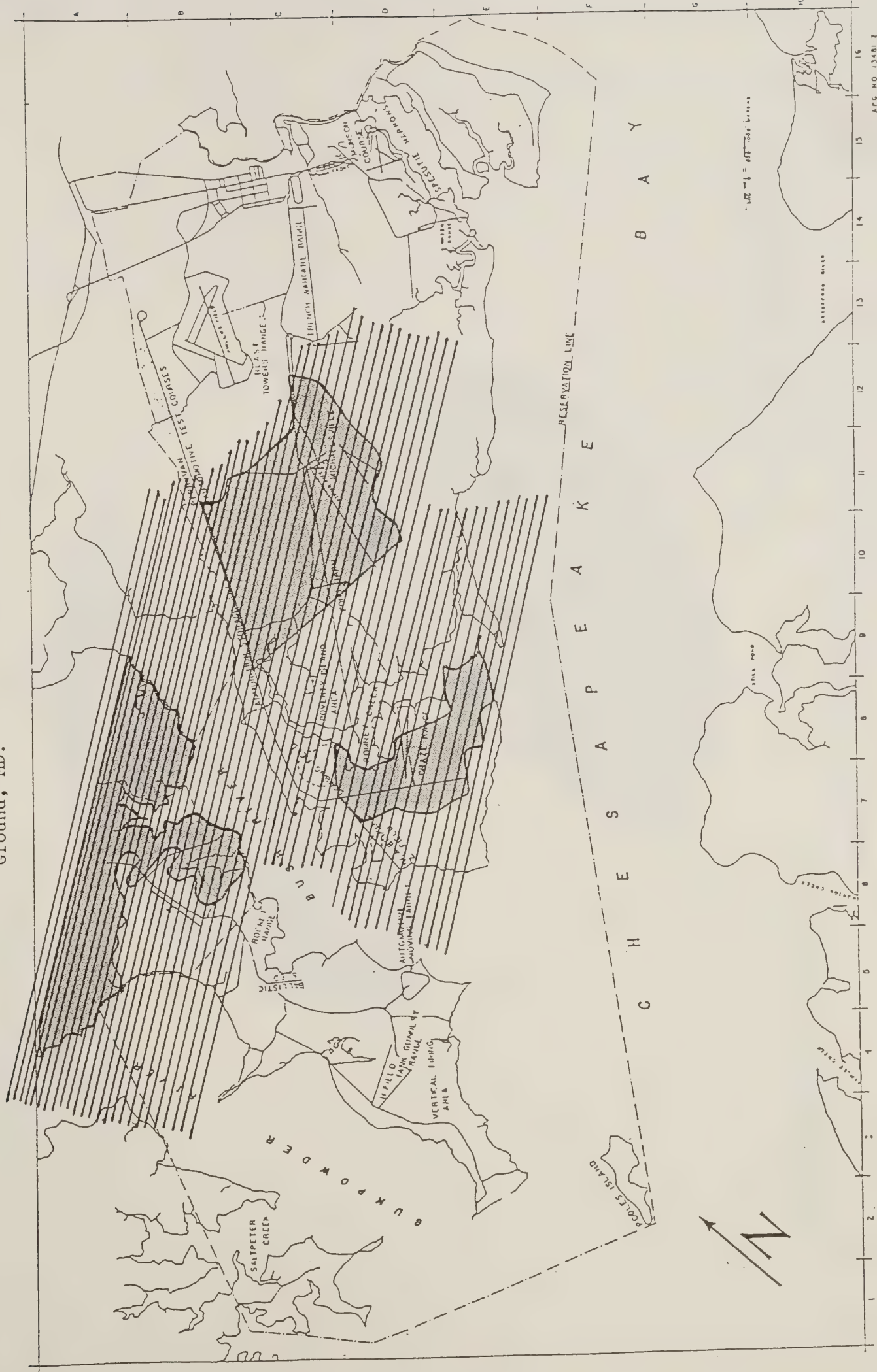
FLIGHT LINE 251°/71°  
ACCEPTABLE 295° TO 25°  
ACCEPTABLE 115° TO 250°

GRAPHIC PREPARED BY USDA, FOREST SERVICE,  
FOREST PEST MANAGEMENT, MORGANTOWN, WV.

FIGURE 5. ABERDEEN PROVING GROUND, MD

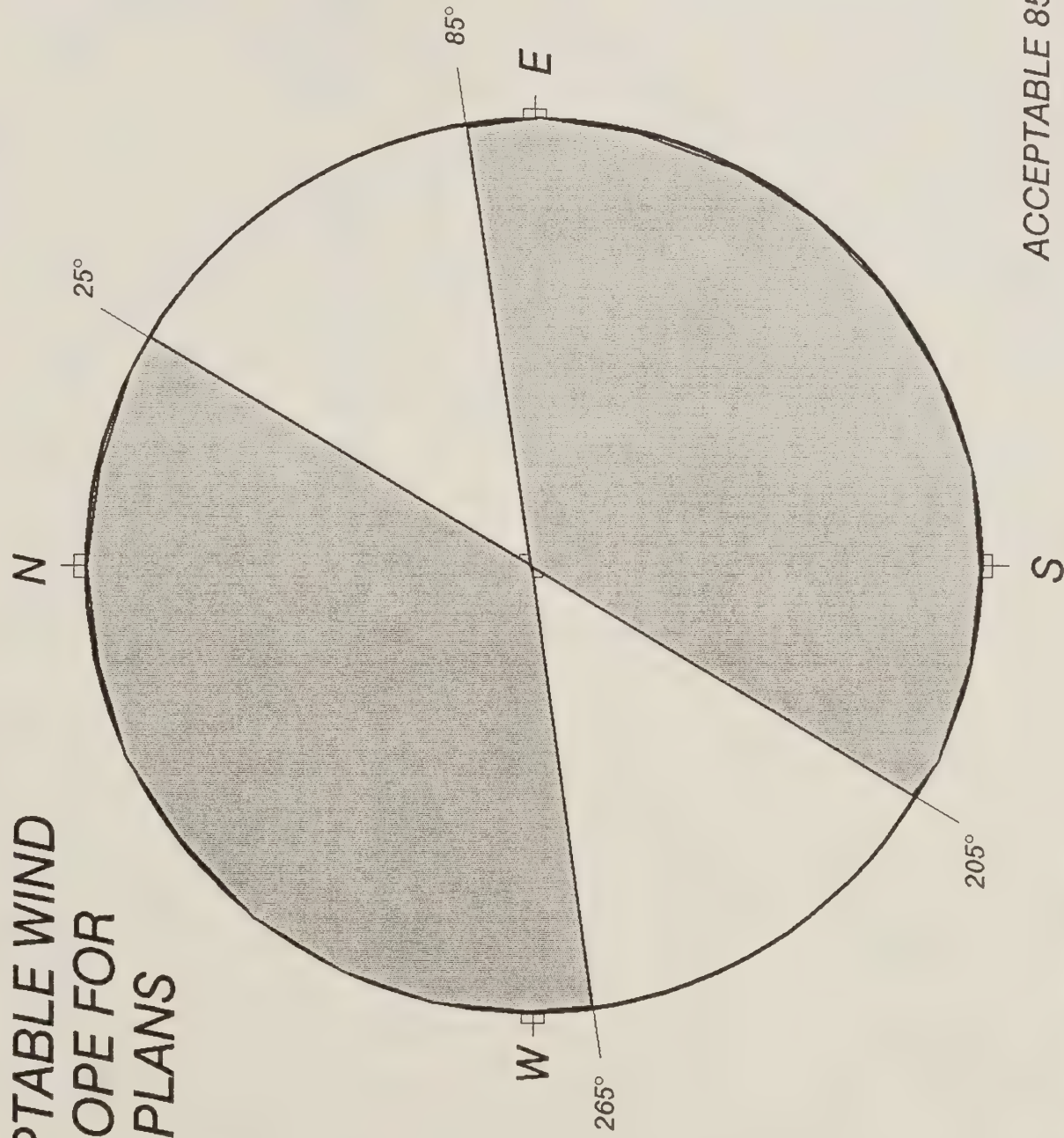


Figure 6. --- Flight line orientation  
for White Plan. Aberdeen Proving  
Ground, MD.





ACCEPTABLE WIND  
ENVELOPE FOR  
BOTH PLANS



ACCEPTABLE 85° TO 205°  
ACCEPTABLE 265° TO 25°

GRAPHIC PREPARED BY USDA, FOREST SERVICE,  
FOREST PEST MANAGEMENT, MORGANTOWN, WV.

FIGURE 7.

ABERDEEN PROVING GROUND, MD



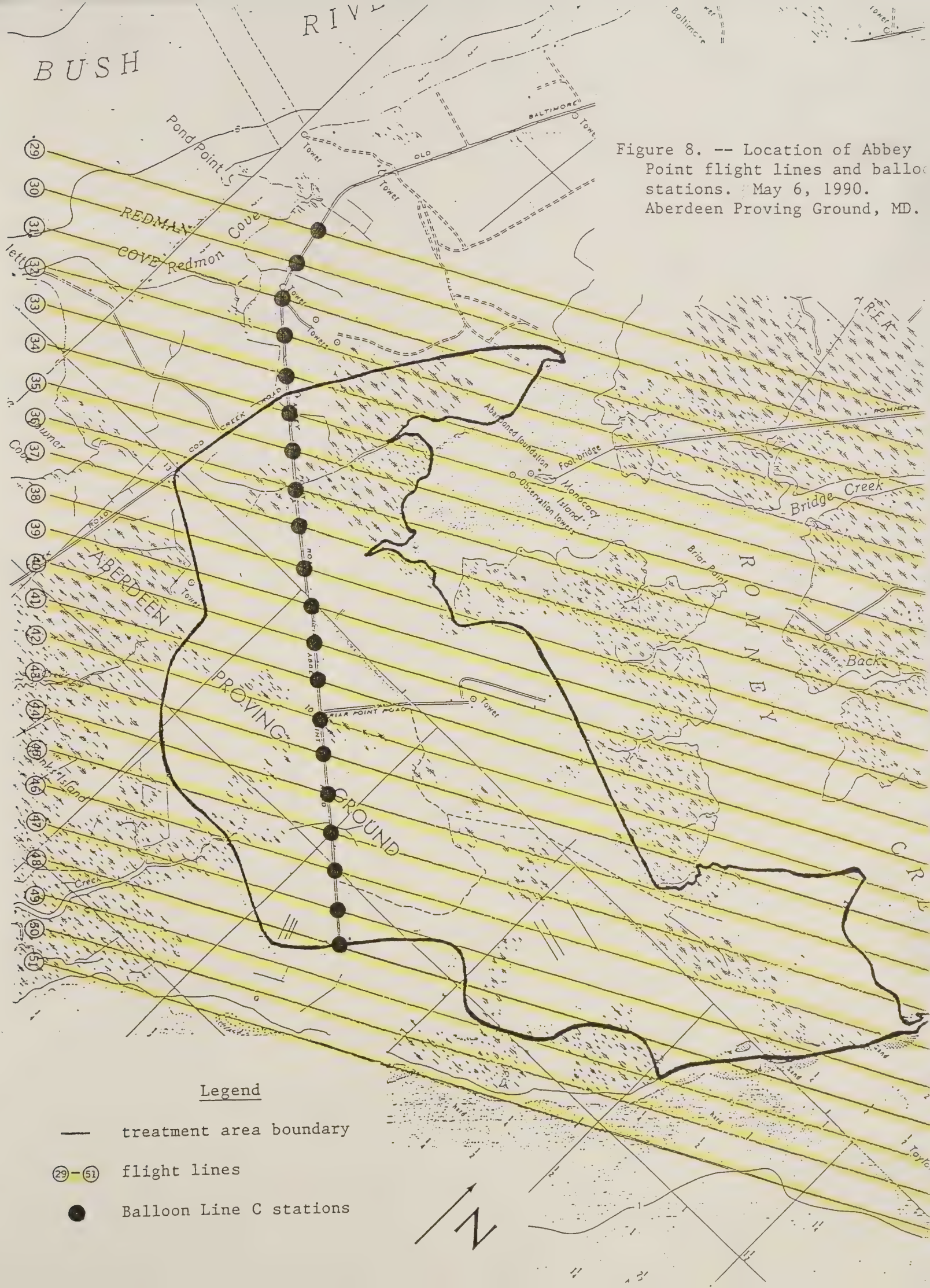




Figure 9. -- Location of Aberdeen-North flight lines and balloon stations for the first application, 6 May and 7 May. 1990 Treatment Area. Aberdeen Proving Ground, Maryland.

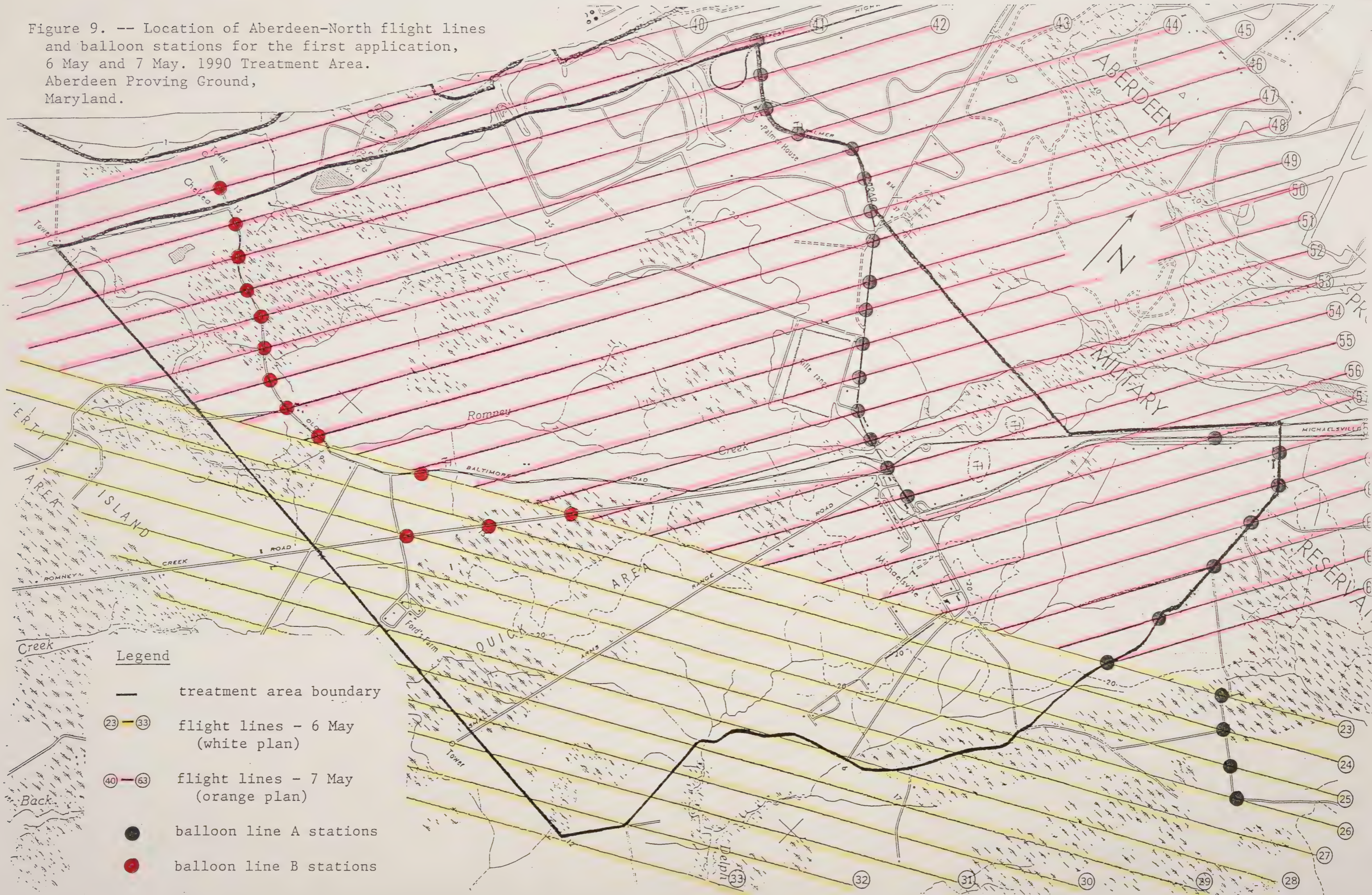




Figure 10. -- Location of Edgewood flight lines and balloon stations for first application, 7 May. 1990 Treatment Area. Aberdeen Proving Ground, Maryland.

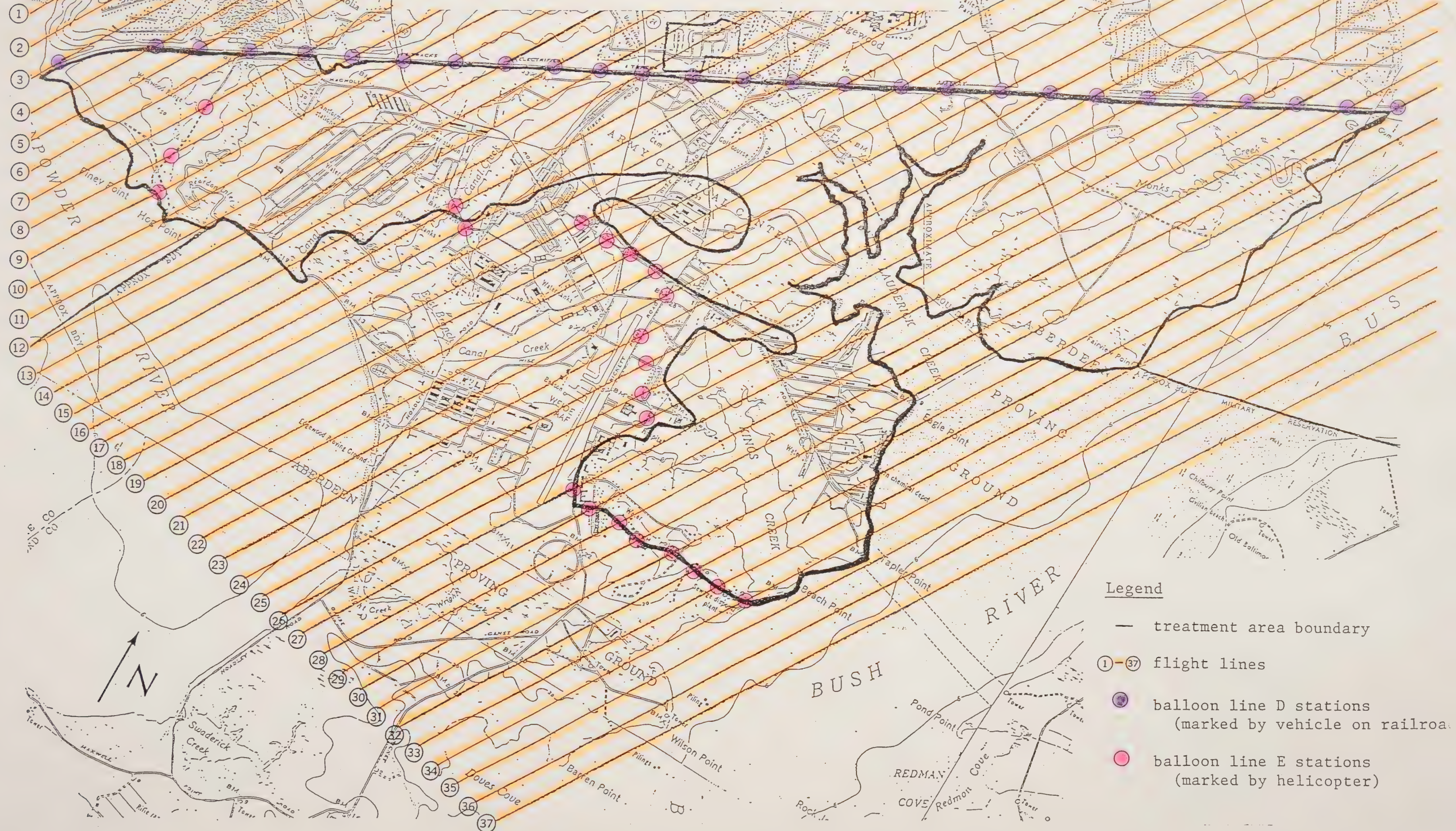




Figure 11. -- Location of Aberdeen-North flight lines and balloon stations for the second application, 12 May, 1990 Treatment Area. Aberdeen Proving Ground, Maryland.

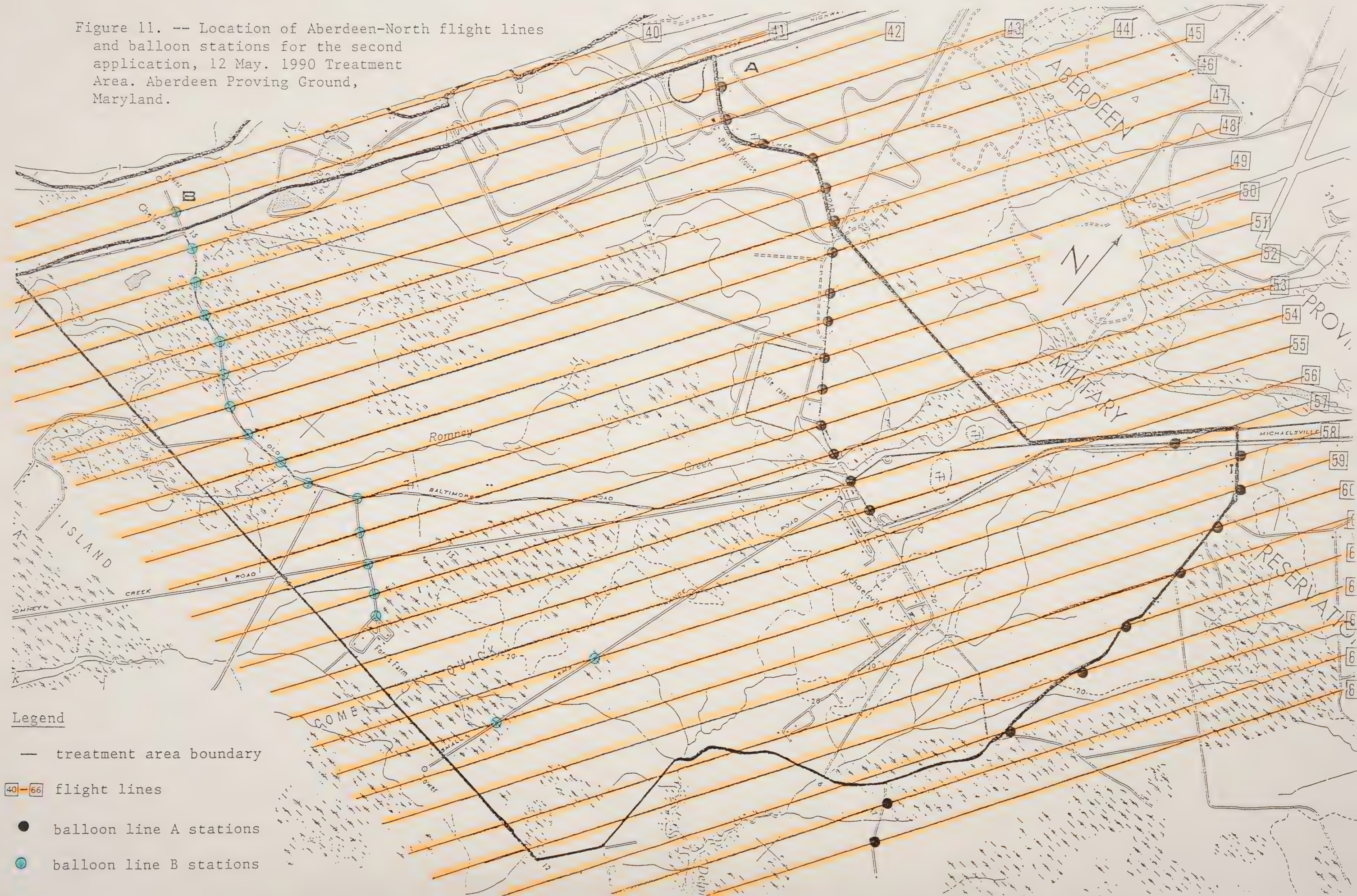




Figure 12. -- Location of Edgewood flight lines and balloon stations for the second application, 12 May. 1990 Treatment Area. Aberdeen Proving Ground, Maryland.

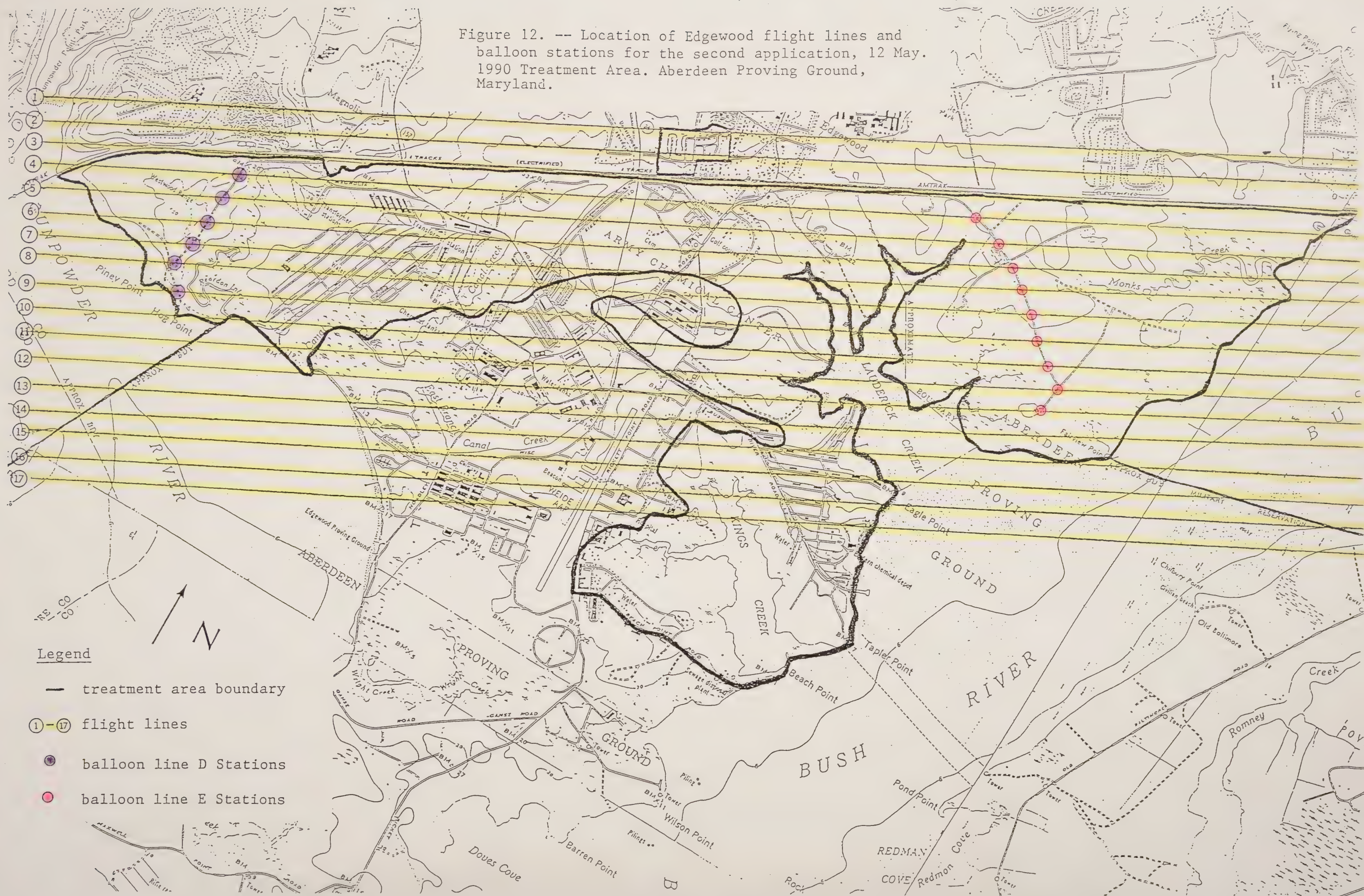
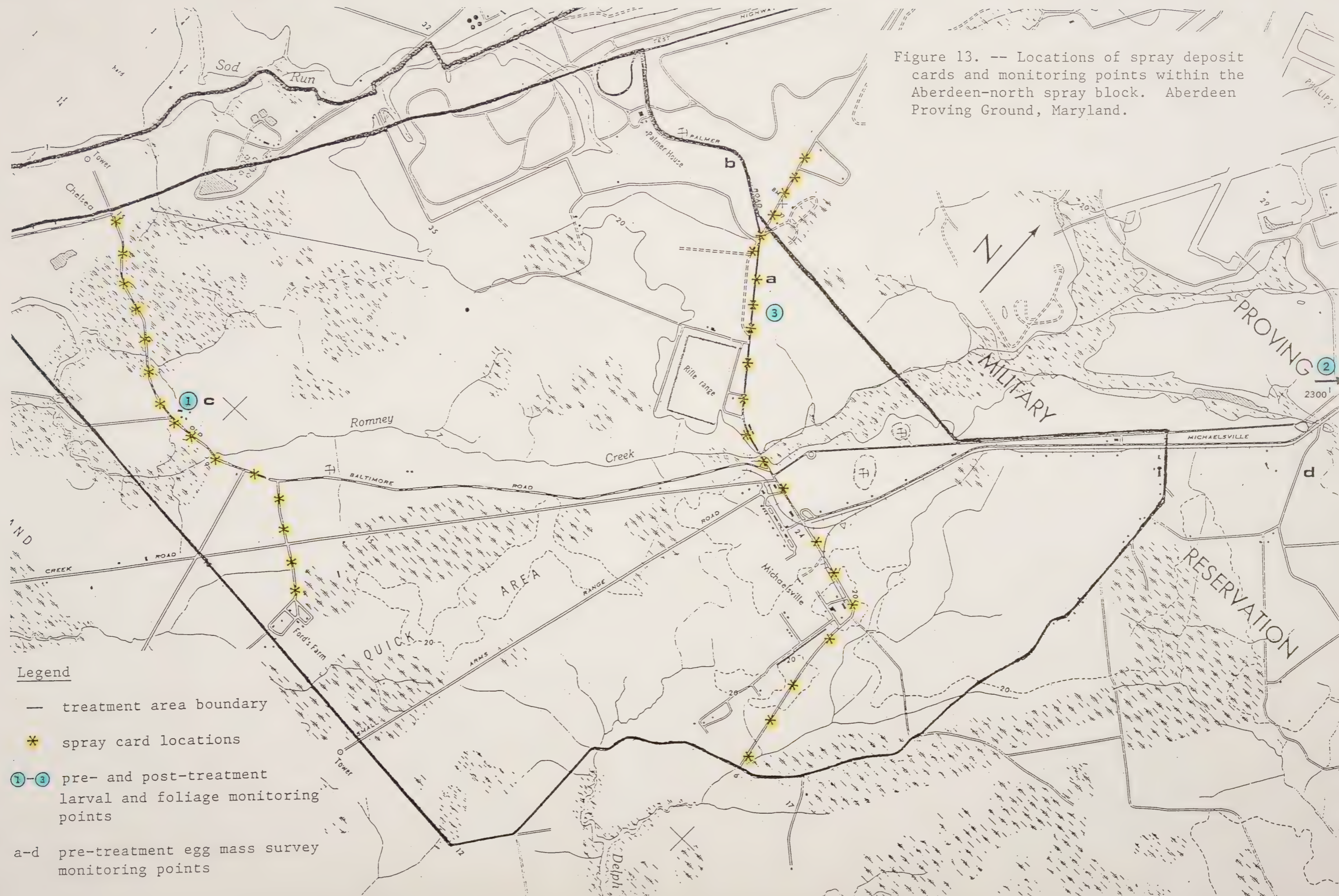




Figure 13. -- Locations of spray deposit cards and monitoring points within the Aberdeen-north spray block. Aberdeen Proving Ground, Maryland.



Legend

- treatment area boundary
- \* spray card locations
- ①-③ pre- and post-treatment larval and foliage monitoring points
- a-d pre-treatment egg mass survey monitoring points



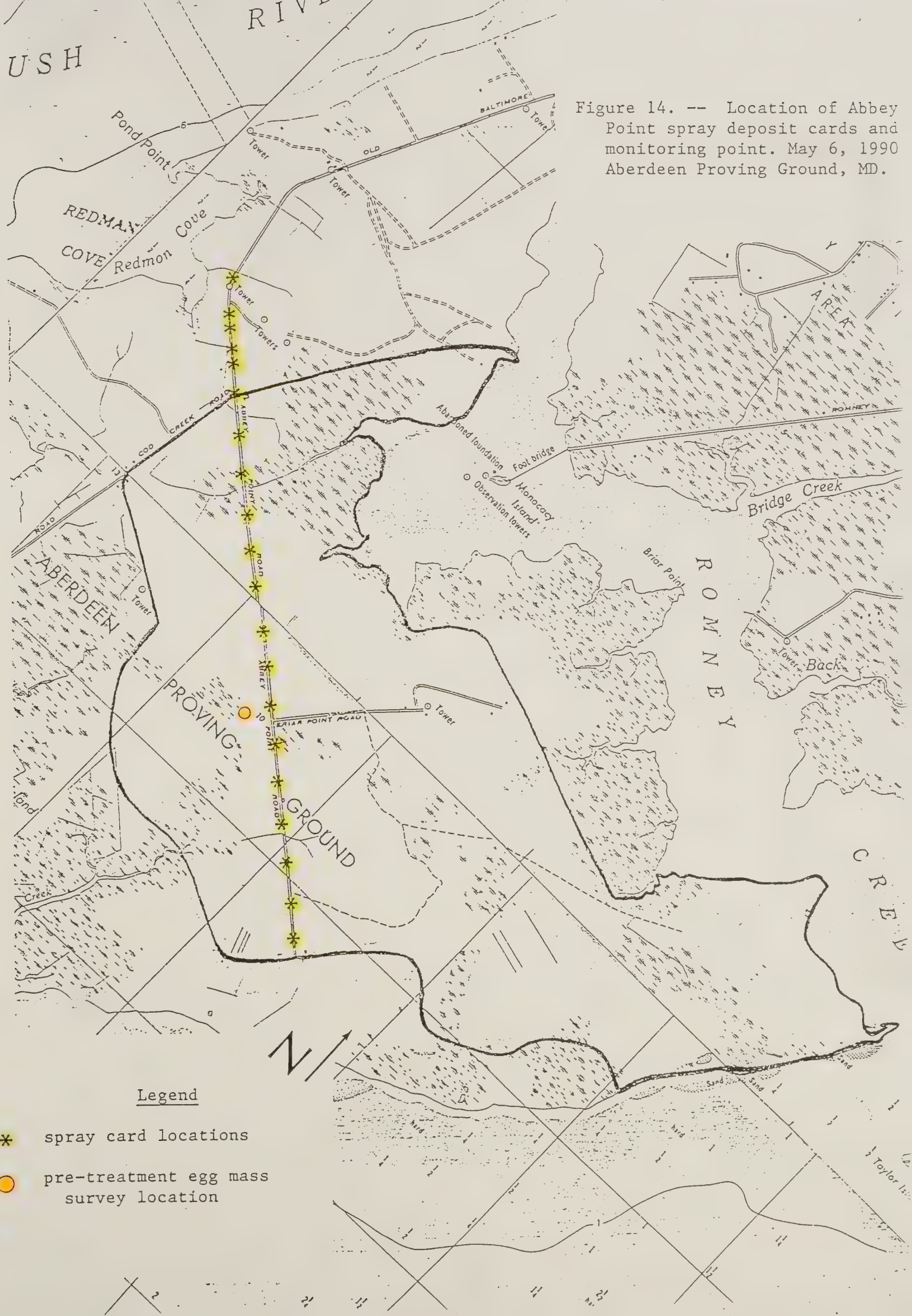




Figure 15. -- Locations of spray deposit cards and monitoring points within the Edgewood spray block. 1990 Treatment Area. Aberdeen Proving Ground, MD.

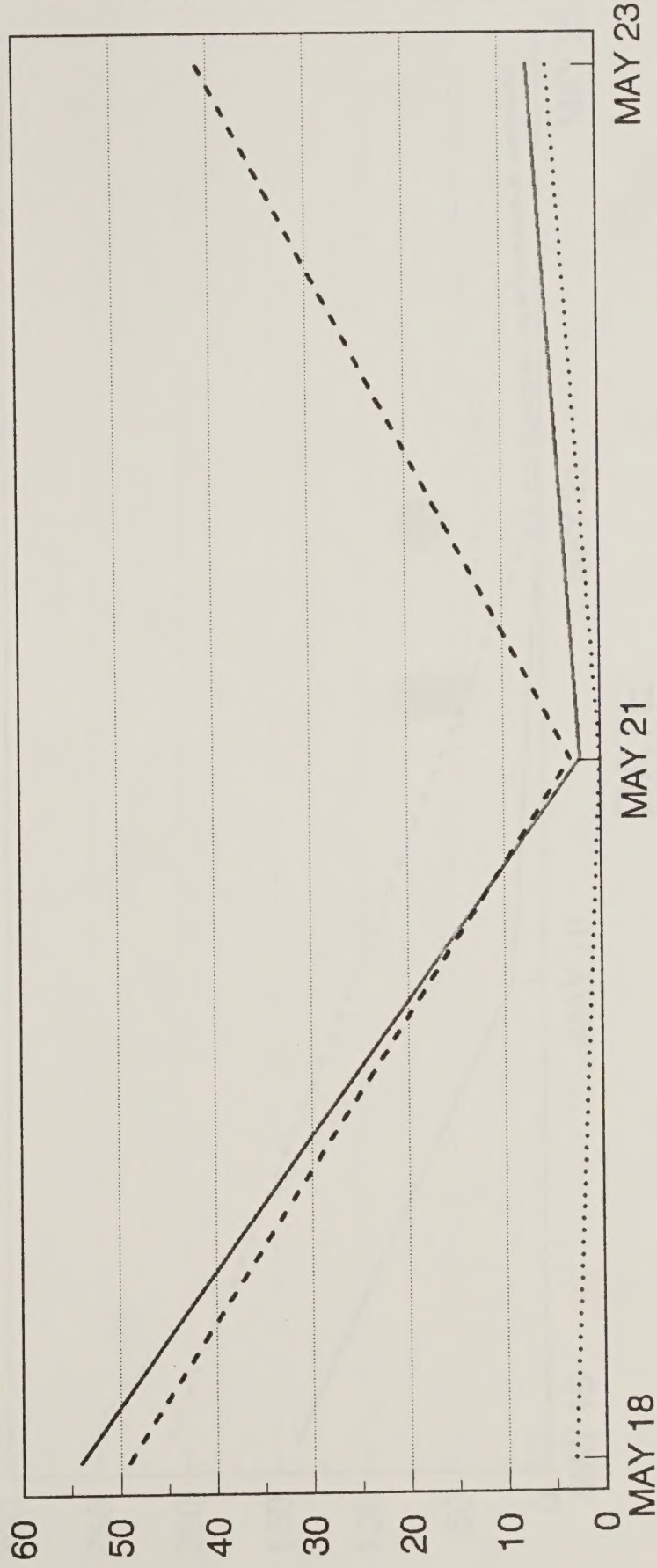




# 1990 BURLAP BANDING RESULTS

Aberdeen, MD

NUMBER OF LARVAE



POINT A POINT B POINT C

2nd Application Started on May 12.

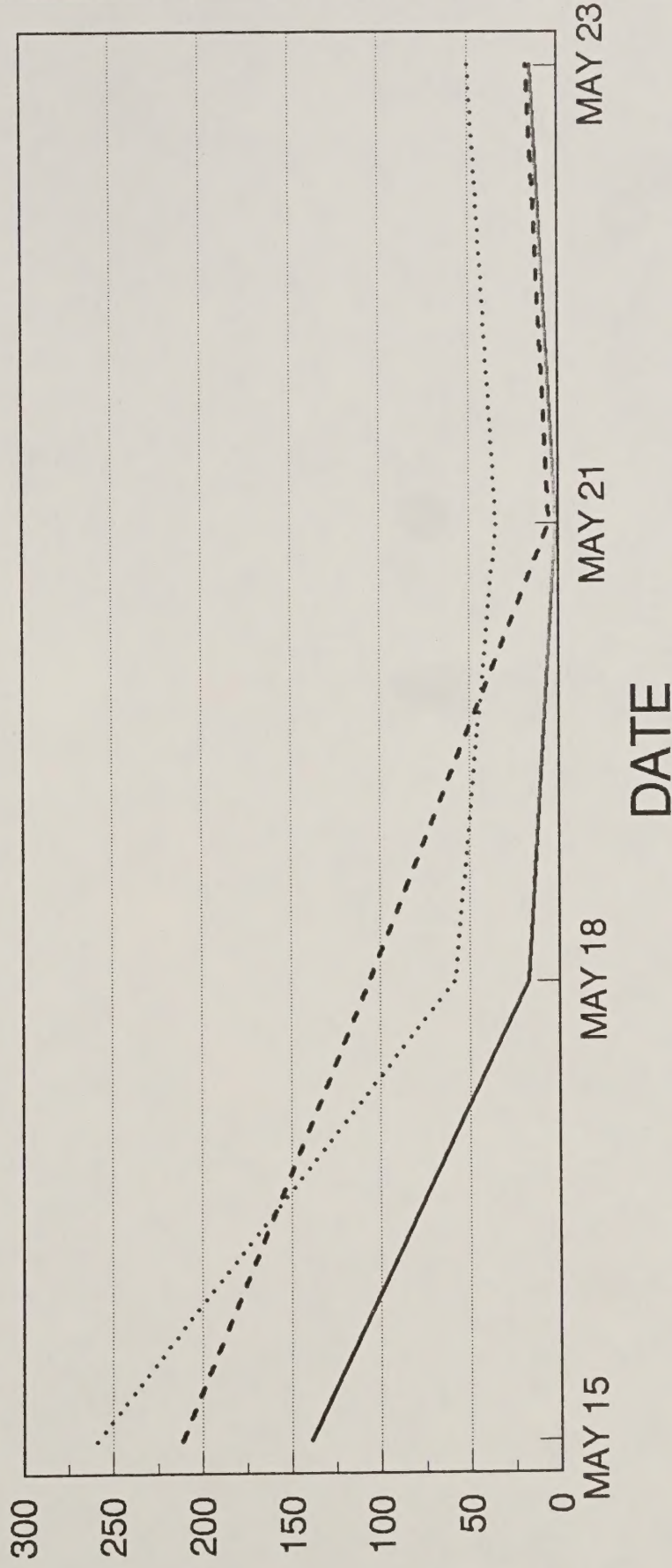
FIGURE 16.



# 1990 BURLAP BANDING RESULTS

Edgewood, MD

NUMBER OF LARVAE



1st Application Started on May 7.

2nd Application Started on May 12.

FIGURE 17.

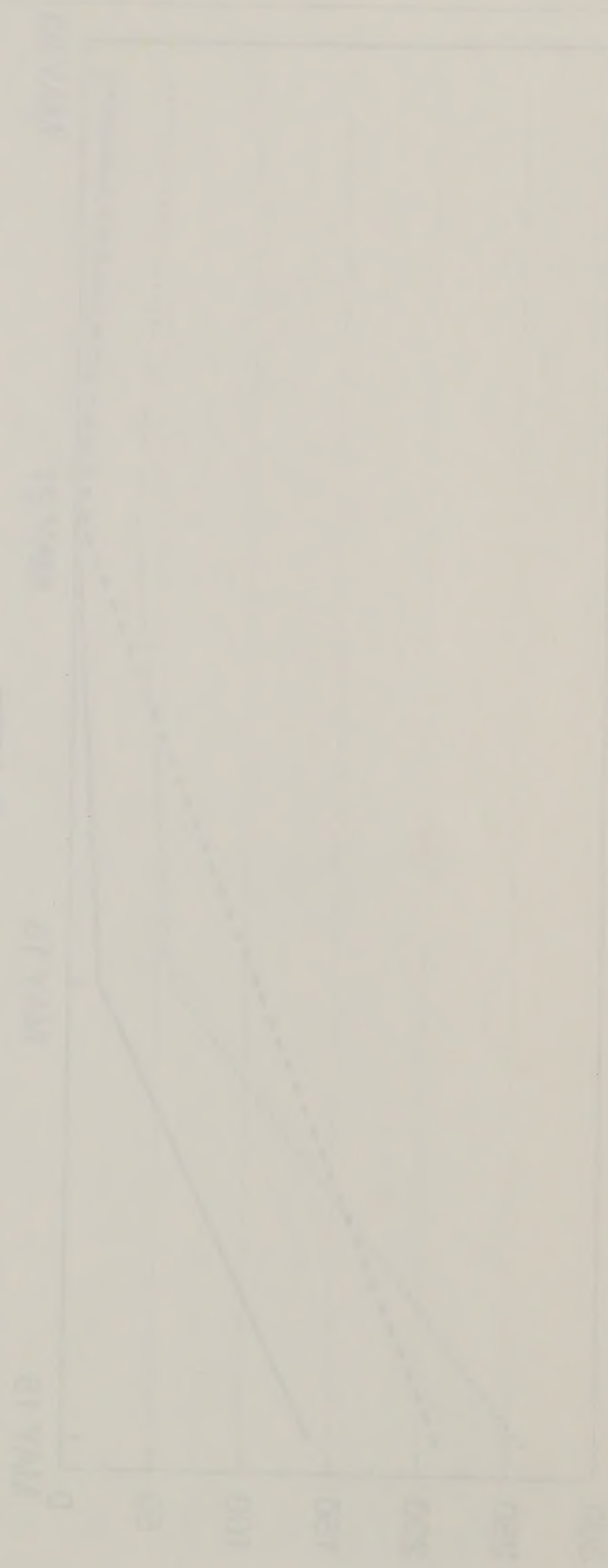


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